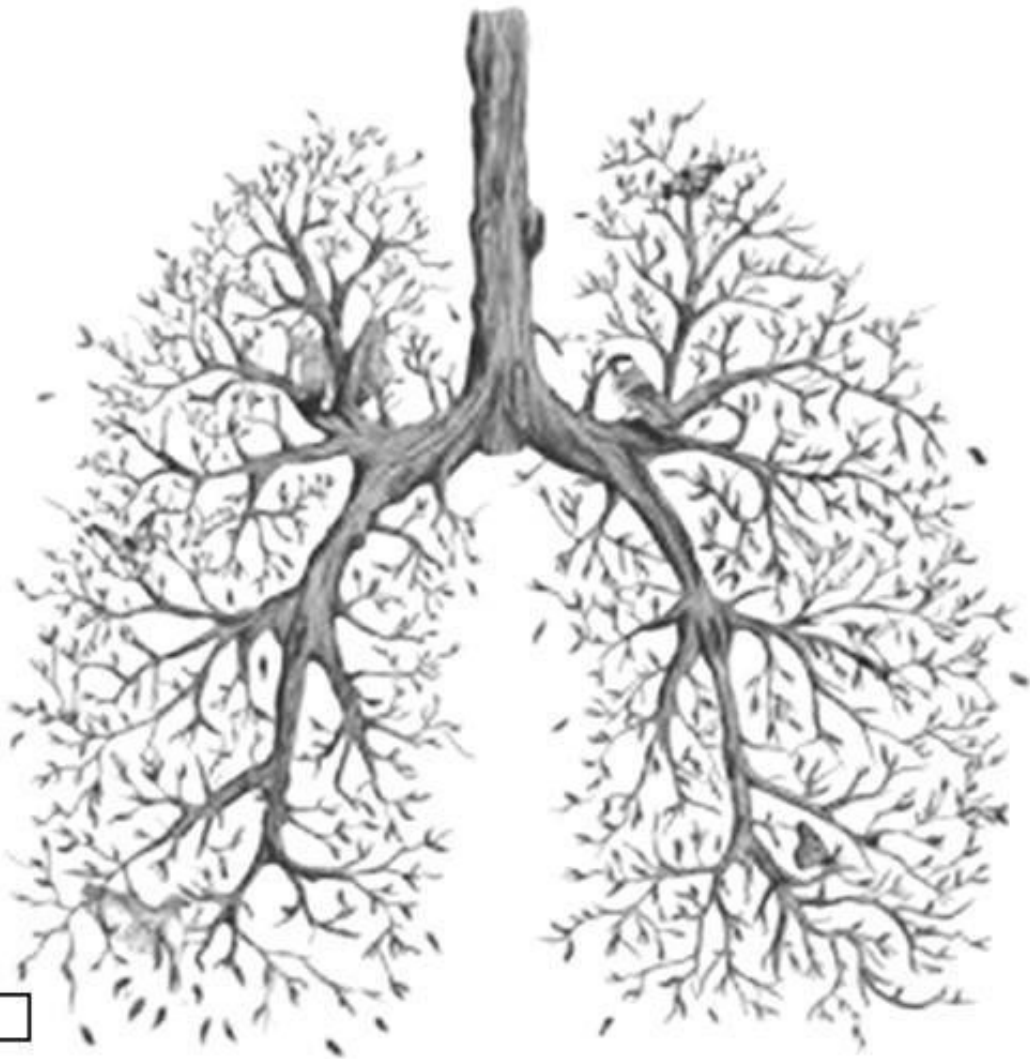


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Medical Committee
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Community Medicine



Slides

Sheet

Lecture # **21**

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Air pollution

-This is the last lecture for Dr.Madi.

-Note: Physical pollution of water is mainly by radiation. (Not very important).

● Air Pollution :

Our total planet is suffocating with air pollution that is becoming increasingly important. Nowadays it is almost impossible to find clean air anywhere on our planet.

Definition: The presence of contaminants or pollutant substances in the air that **interfere with human health and all welfare (الرفاهية)** and produce other harmful environmental effects (not only on human being).

Welfare means: the health, happiness, and fortunes of a person or group. For example: If you buy a car, in some places its body can stay good for 10 or 15 years where in other places it starts to rust as early as 5 years and this is because the level of air pollution is different. Or if someone builds a costly house that is close to a highway in a contaminated area, after few years it will lose its value due to the effects of air pollution on it (rusting, changing its colour...)

Why is it difficult to find clean air?

We have two reasons: 1- **Extensive pollution** 2- **The dispersion of air pollutants.**

So pollution might start in one place and end up having effects in other places.

Examples:

- There was a major volcanic eruption in Ireland and that expanded to cover all Europe and the air navigation was stopped , airplanes weren't capable of functioning and it was close to come to our area .

So this means that sometimes the scale of pollution is so huge and can affect different areas.

-**In the 80s, there** was a major volcanic eruption in Mexico that had an impact on the Middle East .Imagine all that distance that had been affected by those pollutants.

-As we see, the movement of air pollutants is unlimited, regardless of countries' borders. And that was the case when pollutants were produced from the northern part of America and travelled to affect Canada. Also **Sweden** had problems with **Germany** and other European countries in movement of air pollutants toward them.

-When **Russia was** having problems in Chernobyl nuclear power plant in 1986 it was discovered by Sweden. They tried to hide the evidence of those pollutants but Sweden exposed them and revealed the truth.

- The lung is the major body part that separates those pollutants from entering the body. However, a small portion of these pollutants can successfully enter the body and knowing the fact that we breathe around 10 million times a year "in average" , this small portion can ultimately cause an effect.

Breathing can be an indicator of health. One of the things that you will do for your patient in the future is to count his breath to see if he has an Apnoea or any other problem.

How can we say that a particular disease or a problem is important?

We need some indicators to show the impact of the situation. We need to measure the **disease burden** and one way to measure it, is the number of people getting sick or dead.

According to WHO, **disease burden** is defined as the impact of a health problem as measured by financial cost, mortality, morbidity, or other indicators. It is often quantified in terms of quality-adjusted life years (QALYs) or disability-adjusted life years (DALYs), both of which quantify the number of years lost due to **disease**.

-There are two million premature deaths due to air pollution.

What is premature death?

✚ Death before the expected life span in a certain country. If the average lifespan in a country is 60 years, anybody dying before 60 is considered as a premature death. If someone dies at 57 years, he has lost 3 years, another one dies at 40; he has lost 20 years and so on.

-More than half of these diseases and their burdens are found in the developing countries. We are born in the 3rd world facing these problems :/.

-Examples:

You don't need instruments to measure the air pollution in Cairo when you walk in the streets, you can see the pollution by your eye (smog), why?

- 1- Because it is a very crowded city.
- 2- A lot of air pollution.
- 3- It doesn't rain frequently in Cairo, and the air pollutants accumulate in the atmosphere.

To the extent, that you can't wear a white shirt for more than one day without turning black. ☹

In Iran, there are three or four cities that are among the worst places in the level of air pollution, beside several other places in our area.

**The doctor showed a picture that illustrates air pollution in developed countries (industrial areas).

-In developed countries, industrial areas are away from general population to avoid pollution and its effects.

- People usually don't know about diseases or illnesses caused by air pollution. Instead they notice it by the impacts on their daily life, for example, someone was complaining that air pollution prevents him from sitting outside in his house garden. Even doctors, if they had an asthma patient, they just treat the asthma without further investigation about its causes or whether the patient is living in an extensively polluted area.

So, what's happening from air pollution doesn't come to our attention as general public or doctors except in certain situations because we don't feel it but you will face this later and you will see a lot of patients who are diseased due to air pollution.

- Air pollutants in the atmosphere could be: particles, gases and liquid materials.

-Liquid materials: in form of Aerosols which are fine solid particles or liquid droplets in air or gas. We spray pesticides or any kind of fluids then they become suspended in the atmosphere. Even ocean splashes on shores; when water mixes with air it can cause harm.

-Solid materials like pollens, dust, and lead that comes out of cars or from battery industries and they form aerosols.

-Air pollution causes about 2-3 million premature deaths a year mostly from indoor air pollution in developing countries.

- EPA estimates annual deaths in the U.S due to outdoor and indoor air pollution is about 150000-350000.

- The difference between outdoor and indoor:

Outdoor : general environment , the moment you step out of your house "outside".

Indoor : has two parts : one of them is **Home pollution** "we are exposed to pollutants in our home" . The second part is **work place pollution** "majority of people are working indoors".

- Impacts of air pollution :

1- **Acid Rain.**

2- Affect **visibility** (eruption of volcanoes).

3- Affect **water quality and as a result fish.**

4- Affect **humans (through lungs).**

5- **Climate changes** that we notice and see worldwide.

6- **Ozone depletion** "we mentioned it in the first lecture".

7- **Spread of air toxins.**

*So this is another way to show the burden of air pollution.

- History of air pollution.

It is not a recent issue at all; in fact the moment we had human beings on earth, they created fire and we started to have pollution.

But even before this , there was natural sources of air pollution : volcanoes , storms , earthquakes , sudden fires...etc .

In the past, Great Britain had a major importance because it conquered many parts of the world and it affected many places. They are perhaps the first people to have an

act against air pollution (in 1848). While some places lack such regulations until today.

- Cars:

One of the major causes of air pollution is **vehicles "cars"**.

*A figure in the slides shows the great increase in number of cars among the years (1900-1940) and they are still increasing up till now significantly.

-When you buy a new American car it applies to **California emission standards** that limit the amount of air pollutants released to the atmosphere from their vehicles. They created also the **double barrel exhaust** that functions to protect the environment.

These California standards are applied worldwide. But they aren't that much applied in third world countries where for instance the double exhaust barrel is removed without knowing the reason behind it.

London Smog- 1952: (Atmospheric Inversion Phenomena):

*Smog: smoke + fog (خبيثان).

It was normal to have fog in Britain but it came with smoke during December (1952). It was winter and the weather was cold and large amounts of coal were burned for heating purposes. Coal is a dirty kind of fuel , and thousands of people that were in the streets started to have difficulty in breathing and some of them died instantly. So air pollution became a killer, it killed people instantly and doctors didn't know what to do. This phenomenon might happen somewhere else in the world.

** The doctor showed a picture of Los Angeles where you can't see the buildings, but only part of them.

This is called **atmospheric inversion phenomena** or **temperature inversion phenomena** “*instead of having temperature coming less as we go up, it becomes suddenly higher*”. It happened in different parts of the world, killing people instantly, as in New York (several times), Los Angeles, Britain, Holland and valleys.

How does it occur?

When you have air pollution sources, pollutants can move in two ways:

Upward ‘away from us’ and **side movement**. This is the dilution effect of air.

But sometimes a blanket of air stops suddenly on the top of a city, there is No side movement of air so it stagnates (stop flowing). Normally as we go up, the temperature becomes less “cooler” but here (in the blanket) it becomes higher ‘warmer’ with altitude. So when this air stagnates and air pollutants try to move upward, they hit this air blanket and start to accumulate beneath until it reaches the breathing zone (the troposphere) and cause pollution and severe health effects–sometimes death.

What makes the pollutants go upward ?

The hot air is lighter than the cold air so it goes upward and this will reduce the amount of pollutants in the breathing zone. But when this blanket is formed it won’t allow this movement to continue, so pollutants start to accumulate down below that layer becoming close to our breathing zone. ./

Why is this happening?

Sometimes because of the topography of a specific area. High buildings also play a role in preventing air from moving sideways as do mountainous areas.

For example: Downtown Amman can have this problem at anytime because it is surrounded with 7 mountains and the air can stop flowing suddenly. Therefore, planners decided more than 15 years ago that huge vehicles and trucks can’t go there

before 8:00 p.m to avoid the traffic jam and the rush hours and thus prevent air stagnation.

And that is the reason behind having the ring road (الحزام الدائري) so these huge vehicles don't have to go through Downtown Amman to pass. Instead, they can go around Amman through this ring road – A precaution.

*A photo taken before and after the movement of air is a clear document of this phenomenon as buildings are more apparent after air movement.

- We live in the troposphere layer, the lowest portion of the Earth's atmosphere. It has a depth of about 16 km above sea level. Just above the troposphere we have the stratosphere with an altitude of 50 km above the surface, and here we have the ozone layer, so the ozone layer is not within our zone.

When an aeroplane tries to cross through these atmospheric zones it will burn. That is why we need special kinds of aeroplanes that can go upward and be protected from high heat.

Why do aeroplanes travel at high altitudes (35,000 ft)?

To reduce **Gravity**, so the aeroplane will be lighter as it goes upward and it consumes less fuel as a result at higher altitudes than lower altitudes.

-Aeroplanes travel in the stratosphere and participate in damaging the ozone layer beside CFCs.

-The atmospheric regions of interest are: 1- Troposphere. 2- Stratosphere. 3- Chemosphere. 4- Ionosphere.

- If we want to know the quality of air in a room, is it good or bad?

How can we solve this issue?

We need a sample, so we have to take an air sample, by a method called **Grab sample**. We use an instrument that sucks air in a given sack and we take it to the Lab for analysis. It could be a **single sample** or it could be **continuous air sample** (you leave the instrument in the room ,and it will continue to take air samples until next day when we take them to the lab).

What are the components of this air? What is the result of the analysis?

How can you decide if your patient has a problem or not?

You need a standard to compare with and decide the stage of the disease.

And the same goes over here, we need a standard. We already know that there is no clean air, so scientists agreed on defining **hypothetical air** which is the cleanest air that you could reach and it became the reference.

It is characterised by:

-78% Nitrogen.

-21% Oxygen.

-0.4% Carbon dioxide and less than 1% other gases.

*As you see CO_2 doesn't indicate pollution unless it is higher than its normal level.

**We start to accept certain abnormal components in our air as normal, the problem is when they go higher than their normal level .

- **Sources of air pollution :**

1- Natural sources : we have natural sources like volcanoes , Forest fires “Not manmade “ , earth quakes , Trees.

How could trees be a pollutant source? Through pollens that can cause asthma or through volatile materials – named volatile organic compounds (VOCs).

2- Manmade: industrial, deliberate fires “burning”, etc.

Now these sources can be classified again in other ways:

- ❖ **Point sources vs Nonpoint sources**

1- **Point source** : well defined source , I know from where it is coming

2- **Nonpoint source** : diffuse source.

- ❖ **Mobile sources vs Fix sources**

1- **Mobile source**: cars, aeroplanes,...

2- **Fix source** : house , factory , ...

- ❖ **Point sources vs linear sources**

1- **Point source** : one house .

2- **Linear source** : group of spots like a highway “ each car is a spot “

It is important to know this because this is the way to fight air pollution.

- In Philippines, 6 years ago there was a major volcanic eruption; houses were damaged not by lava but rather by ashes only. Ashes accumulated above some houses until these houses were damaged, and people couldn't move for several days without having masks.

We use the same thing when we talk about water as well, we can classify the sources of water pollution in the same manner.

>> Pollutants in general can be classified into **primary** and **secondary pollutants**.

1- **Primary** : come from their origin as pollutants .

2- **Secondary**: they are produced later in the atmosphere like: Ozone. Is Ozone a pollutant?

If Ozone remains in the stratosphere it is beneficial, when it is close to our breathing zone it is considered as a pollutant , it becomes harmful and causes problems.

*Air components vary between different places.

>>**Sulphur dioxide (SO₂)** is one of the major air pollutants. Sulphur comes from oil while burning and oxygen comes from the atmosphere.

➤ SO₂ causes upper respiratory tract irritation, but it kills people in London, How come? Can you die just because you have irritation in your nose or your throat? NO.

So what happened is: SO₂ was adsorbed to solid particles “ashes” and those solid particles managed to reach the lungs (SO₂ is in the lung), and this is how it became a killer.

**The price of oil worldwide becomes cheaper when it has more sulphur. The worst thing is coal; coal contains a lot of sulphur.

➤ NO₂ ,NO₃, N₂O ..etc those come as a result of burning. Nitrogen and oxygen both come from the atmosphere , you don't have to get nitrogen from a burning source. Just the burning itself of any source will produce these compounds and this is another pollutant which can cause **asthma in children** .

➤ CO , there are a lot of cases of carbon monoxide toxicity ,especially in winter when stoves are used and incomplete burning occurs , and what we measure in such cases is carboxyhaemoglobin because haemoglobin at this time doesn't like oxygen , it likes CO(a higher affinity) which makes it a very dangerous material . CO toxicity causes



confusion and misjudgement- If someone wakes up, instead of opening the doors and the windows, he will close them tightly and worsen the situation.

Good Luck ☺

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